Momentum
Tutorial-II

How to solve Momentum conservation equation

- Law of conservation for isolated system $p_1+p_2=p_{f1}+p_{f2}$
- First read the problem and understand the quantities given
- Choose a suitable system where law of conservation of momentum can be applied.
- It can be for certain time duration also.
- Importance should be given to this step
- Choose a suitable Coordinate system and write down the momentum equation in XYZ axes.
- Note we need to add all the object in the system in the momentum equation and find the unknown
- Incase of collisions , if the collision are elastic ,apply kinetic energy conservation also
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Question

A 2 g bullet is fired horizontally with the speed 300 m/s into a .8kg block of wood at rest on the table. The bullet lodges into the block . If the coefficient of friction between the block and the table is .03

a) What is the velocity of block after the bullet is lodges into the block

b) How far will the block slide

c)how much energy is lost by the bullet in collision

d) How much energy is dissipated in friction

Solution

- First we need to understand the problem and find out the known and unknown. Initial momentum of bullet is known
- Here first collision happens and then bullet and block system moves and friction opposes the option and they come to rest
- Choose the suitable system. Here Bullet and block can be taken as the system. So in collision Law of conservation can be applied. After the collision ,we can use Work and energy method
- Since this is one dimensional collision . we just need to consider everything in one axis
- So applying law of conservation for the collision part

Initial momentum=.002X300=.6 kg m/s ,
Final momentum = (.8+.002)v
Now initial momentum=final momentum
V=.748 m/s.
This cover the answer (a)

Solution continued….

Now the frictional force acting will be

$f=\mu(M+m)g$

Now from work kinetic energy equation we know that

$-fs=\Delta KE$

$\mu(M+m)gs=(1/2)(M+m)v^2$

Or s=.093m (answer b)

Now energy lost by bullet in collision

=Intial energy of bullet – Final energy of block +bullet system after the collision

$=(1/2)X.002X(300)^2 -(1/2)(.802)X(.748)^2=90-.224=89.776$ Joule

Answer is C

So energy dissipated in friction $=(1/2)(.802)X(.748)^2=.224$ J

Answer is D

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